

Abundance and distribution of *Anopheles* mosquitoes in a malaria endemic area along the Thai-Lao border

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ABSTRACT: Malaria is an important public health problem in Thailand, especially along international borders. In this study, we conducted a longitudinal entomological survey in six villages and rubber plantation sites to address the spatio-temporal abundance and behavior of malaria vectors in Ubon Ratchathani Province along the Thailand-Laos border. Adult female mosquitoes were collected by human landing collections (indoor and outdoor) and by cattle bait collections twice per year, during rainy and dry seasons. Mosquitoes were morphologically identified and sibling species were determined by allele-specific PCR. Of the 10,024 *Anopheles*, 9,328 (93.1%) and 696 (6.9%) were collected during the rainy and dry seasons, respectively. A total of 9,769 (97.5%) and 255 (2.5%) was collected on cattle and human baits, respectively. Very few primary and secondary malaria vectors were collected, consisting of 12 specimens of *An. dirus*, eight *An. minimus*, and seven *An. aconitus*. Of the 152 specimens of the Maculatus Group, only three were identified to *An sawadwongporni* by molecular methods. The others were 112 *An. rampae*, a non-vector, that were not amplified or were misidentified as other non-vectors. The very low density of primary malaria vectors found in the study villages suggests that entomological risk and malaria transmission is higher in neighboring forest areas. Further studies on malaria vector distribution, as well as human behaviors, are needed to understand malaria transmission dynamics in the province and to develop suitable vector control methods. *Journal of Vector Ecology* 42 (2): 325-334. 2017.

Keyword Index: Malaria vector, mosquito abundance, behavior, Thailand-Lao border.

INTRODUCTION

Over 3 billion people live in malaria endemic regions in 91 countries and territories. Approximately 1.4 billion people are at risk globally and 237 million are at high risk of malaria in Southeast Asia. According to the latest World Health Organization estimates, the Greater Mekong Sub region (GMS), which includes Cambodia, China's Yunnan Province, Lao PDR, Myanmar, Vietnam, and Thailand, cut the malaria case incidence by about 54% and malaria death rates went down by 84% from 2012 to 2015. Myanmar is the only country in the GMS where malaria remains high, accounting for 55% of the total number of malaria cases in the region. The regional strategy for malaria elimination aims at eliminating remaining malaria foci in all GMS countries by 2030, maintaining a malaria-free status, and preventing reintroduction. The strategy also includes urgent action to eliminate *Plasmodium falciparum* malaria by 2025 to contain the spread of multi-drug resistance, which is prevalent in eastern Myanmar, western Cambodia, Thailand, southern Vietnam, southern Laos, and northeastern Cambodia (Ashley et al. 2014).

Vector control is an important component of the global plan for malaria control and elimination, relying essentially on long-lasting insecticide-treated nets (LLINs) that provide protection against indoor-biting malaria vectors. In the GMS, very efficient malaria vectors belonging to the members of the *Leucosphyrus* group (*Neomyzomyia* series), the *Maculatus* group (*Neocellia*

series), and the *Minimus* subgroup (*Myzomyia* series) coexist in sympatry. Several other potential vectors are present, such as the *Anopheles barbirostris* group, which is a suspected vector potentially having an increasing role in malaria transmission along the Thailand-Cambodian border (Limrat et al. 2001) and Thailand-Myanmar border (Sriwichai et al. 2016). Most of the malaria vectors are members of genetically related sibling species that differ in their behavior, ecology, and epidemiological characteristics, including susceptibility to malaria parasites (Tainchum et al. 2015). In Thailand, greater than 50% reduction in the number of malaria cases was recorded between 2000 to 2013. Elimination goals and objectives in approved national plans for Thailand are now to eliminate malaria in 95% of districts by 2021 and, together with Cambodia, to have eliminated all malaria by 2024. Unfortunately, malaria transmission persists in the forested rural areas along the national borders with Myanmar, Cambodia, Malaysia, and Lao PDR. Malaria is generally the highest in the western provinces along the Thailand-Myanmar border (Konchom et al. 2003, Zhou et al. 2005, Carrara et al. 2006), especially in Tak Province, which reported incidence rates of 11.67 cases per 1,000 population. In the northeastern part of Thailand, located at the Lao-Cambodian borders, malaria incidence is generally low. For example, fewer than 700 annual malaria cases were reported in Ubon Ratchathani Province during 2003-2013, corresponding to a malaria incidence of 0.11-0.44 per 1,000 population. However, a large outbreak of malaria occurred in the province in 2014, with